PROTECTIVE PAD APPARATUS HAVING AIR VENTILATING AND RESTRICTIVE RADIANT HEAT TRANSFER/ABSORPTION ASPECTS

[0001] This application claims the benefit under 35 USC 119(e) of U.S. Provisional Application No. 60/437,952, filed on January 3, 2003.

FIELD OF THE INVENTION

[0002] This invention relates to an apparatus for protecting the shoulders, chest, and back of an athlete or other user.

BACKGROUND OF THE INVENTION

[0003] In present day football, football players are instructed to tackle or block by directing the impact forces of the tackle or block into their shoulders and driving with their legs. Consequentially, there are fewer head and neck injuries than years ago, when tacking or blocking was performed by leading with the helmeted head into the chest area of the ball carrier.

[0004] Conventional shoulder, chest, and back pad apparatuses designed for use by football players (football shoulder pads), usually allow the players to tackle or block using the above shoulder impaction technique, without suffering injury. However, Brachial Plexus injuries, i.e., injury to the Acromio Clavicular Joint more commonly known as a separated shoulder, have been rising in frequency. The increase in Brachial Plexus injuries has lead football equipment managers and trainers to demand more protection from football shoulder pads.

[0005] Most conventional football shoulder pads typically have an outer shell which is molded in a high-density-high molecular weight polyethylene. This material has been proven effective in withstanding impacts commonly encountered in football. However, the most popular designs

are molded in a dark colors, such as gray, which undesirably aid the shell in absorbing external ambient heat from the sun. Moreover, the outer shell of these popular designs, do not allow air ventilation.

[0006] The outer shell is typically constructed in two halves, wherein each halve includes an arch-shape inner shoulder protector portion, a chest protector or front blade portion extending from one end of the inner shoulder protector portion, a back protector or rear blade portion extending from the other end of the inner shoulder protector portion, an outer shoulder protector panel, and a lower shoulder protector panel. The rear blade portions of the two halves of the outer shell are connected to one another so that the rear blade portions are fixedly positioned relative to one another and are incapable of moving independently of one another. The inner shoulder protector portion, the front blade portion and the rear blade portions of each shell halve are molded as a single unitary member. The front and rear blade portions, which are molded flat, tend to be susceptible to stress fractures or cracking over time or from repeated impacts. When fracturing or cracking occur, the front blade/inner shoulder/rear blade unit must be discarded and replaced by a person with the knowledge and tooling to make such repairs. The front blade portions of the outer shell halves are typically tied to one another using strings or shoelaces, which are threaded through "eye holes" in the front blade portions. When the strings or shoelaces are properly tightened, a gap of approximately two inches exists between the front blade portions. Although this gap is relatively small, it does leave the football player's body open and unprotected in this area.

[0007] The inner surface of the outer shell is lined with a protective padding that rests against the player's body. In conventional football shoulder pads, this padding is typically comprised of "open cell" polyurethane and/or "closed cell" vinyl nitrile foam. A substantially non-air-

ventilating nylon cover encapsulates the foam(s) and operates in conjunction therewith to create an "air system". In the air system, air trapped in the cells of a section of foam which has been compressed from an impact, is transferred, to a section of the foam not compressed from the impact. The non-air-ventilating nylon cover functions in this system to control and regulate the air being transferred in the foam during the impact.

[0008] Although the nylon cover is substantially non-air-ventilating, the foam can still manages to absorb perspiration and water. Since existing padding design provide no practical way to open the cover to clean or disinfect the foam, mold and mildew can grow inside the padding and potentially make the wearer ill. The perspiration and water absorbed in the foam also increases the weight of the padding which must be carried by the football player during play. Furthermore, when the nylon cover of the padding becomes wet with oily perspiration, the shoulder pads become slippery and may shift dangerously when a collision occurs.

[0009] The padding of conventional football shoulder pads has proven to be somewhat effective in absorbing the shock of an impact, the padding, however, does not allow the football player's body to cool itself. This is because the foam used in the padding has heat transfer properties (high R factors) that do not allow heat dissipation, and thus, operates as an heat insulator. The non-air-ventilating nylon does not allow heat and air to flow through the padding, thus, effectively adding to the heat insulative nature of the padding. Hence, the padding employed in conventional football shoulder pads actually speeds up the overheating of the player's body by not allowing internally generated heat to escape. Accordingly, conventional football shoulder pads are actually a major contributor to the overheating process of the body.

[0010] The protective padding is typically permanently attached to the outer shell, or removably attached to the outer shell with a hook and loop fastening system. The hook and loop

fastening system is very labor intensive and often difficult to master on some football shoulder pad designs.

[0011] A football player experiences a total heat load which is determined by the time spent on the field, the intensity of play, the clothing and equipment worn, the temperature on the field, and the air circulation on the field. If the heat load is sufficiently severe, effects on the player's health and performance will occur. These effects range from decreased concentration to injuries including painful cramps, fainting, heat exhaustion, heat stroke, and sometimes death, which require immediate medical attention by the team trainer or doctor. As should be apparent from the above discussion, conventional football shoulder pads only address injuries related to impact, and do not address injuries relating to heat load. Moreover, conventional football shoulder pads actually increase the heat load because they block the body's ability to dissipate heat generated thereby.

[0012] Body cooling safety issues should be especially important in football shoulder pad apparatus design because June, July, August, and September have the highest temperatures during the year and are the months when football programs commence, at every level of competition. Furthermore, the "bowl" shape of the typical football stadium, traps the sun's infrared rays and causes what is known as the "greenhouse" effect. As a result, the field temperature during competition may be as high as 120 degrees Fahrenheit. Athletes who participate in these conditions generate body heat internally with physical activity, which is augmented by exposure to the hot sun. The resultant high level of body heat mitigates against an effective performance and can be dangerous and sometimes lethal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 is a front elevational view of an illustrative embodiment of a protective pad apparatus.

[0014] FIG. 2 is a rear elevational view of the protective pad apparatus of FIG. 1.

[0015] FIG. 3 is a side view of the protective pad apparatus of FIG. 1.

[0016] FIG. 4 is a plan view of the protective pad apparatus of FIG. 1 showing the interior or athlete body side of the apparatus of FIG. 1 with one of the front, inner and back shoulder cushioning pads removed.

[0017] FIG. 5 is an enlarged view of a section of the interior of the apparatus of FIG. 4 showing one of two spring elements.

[0018] FIG. 6 is a plan view of an embodiment of one of the chest cushioning pads illustrating an outer surface (faces the shell assembly) thereof.

[0019] FIG. 7 is a plan view of the chest cushioning pad shown in FIG. 6 illustrating an inner surface (faces the athlete) thereof.

[0020] FIG. 8 is a plan view of an embodiment of one of the inner shoulder cushioning pads illustrating an outer surface (faces the shell assembly) thereof.

[0021] FIG. 9 is a plan view of the inner shoulder cushioning pad shown in FIG. 8 illustrating an inner surface (faces the athlete) thereof.

[0022] FIG. 10 is a plan view of an embodiment of one of the back cushioning pads illustrating an outer surface (faces the shell assembly) thereof.

[0023] FIG. 11 is a plan view of the back cushioning pad shown in FIG. 10 illustrating an inner surface (faces the athlete) thereof.

[0024] FIG. 12A is a cross-sectional view illustrating the construction of an embodiment of the inner shoulder cushioning pad.

[0025] FIG. 12B is a cross-sectional view illustrating the construction of another embodiment of the inner shoulder cushioning pad.

[0026] FIG. 12C a cross-sectional view illustrating the construction of a further embodiment of the inner shoulder cushioning pad.

[0027] FIG. 12D is a cross-sectional view illustrating the construction of an embodiment of the channel cushioning pad.

[0028] FIG. 13A is a cross-sectional view illustrating the construction of an embodiment of the chest, back, lower shoulder, and deltoid cushioning pads.

[0029] FIG. 13B is a cross-sectional view illustrating the construction of an another embodiment of the chest, back, lower shoulder, and deltoid cushioning pads.

[0030] FIG. 14 is a cross-section view illustrating the construction of an embodiment of the outer shoulder cushioning pad.

[0031] FIG. 15A is a plan view of a section of the protective pad apparatus illustrating an embodiment of a strap which may be used for connecting the lower shoulder panel to the inner shoulder panel.

[0032] FIG. 15B is a plan view of a section of the protective pad apparatus illustrating an embodiment of a dual strap which may be used connecting the lower shoulder panel to the inner shoulder panel.

[0033] FIG. 16A is an elevational view of an embodiment of a sternum protector plate of the protective pad apparatus.

[0034] FIG. 16B is an elevational view of another embodiment of a sternum protector plate of the protective pad apparatus.

[0035] FIG. 17A is an elevational view of an embodiment of a spine protector plate of the protective pad apparatus.

[0036] FIG. 17B is an elevational view of another embodiment of a spine protector plate of the protective pad apparatus.

[0037] FIG. 18A is an elevational view of a shell assembly panel illustrating an embodiment of a raised embossment.

[0038] FIG. 18B is an elevational view of a shell assembly panel illustrating another embodiment of a raised embossment.

[0039] FIG. 19 is an elevational view of one of the shell assembly halves.

[0040] FIG. 20 is cross-sectional view illustrating the construction of an embodiment of the spring element.

[0041] FIG. 21 is a front elevational view of another illustrative embodiment of a protective pad apparatus.

[0042] FIG. 22 is a rear elevational view of the protective pad apparatus of FIG. 21.

[0043] FIG. 23 is a side view of the protective pad apparatus of FIG. 21.

[0044] FIG. 24 is a side elevational view of an embodiment of a belt strap cushioning pad.

[0045] FIG. 25 is a plan view of another embodiment of a chest or back cushioning pad illustrating an outer surface (faces the shell assembly) thereof.

[0046] FIG. 26 is a front elevational view of a further illustrative embodiment of a protective pad apparatus.

[0047] FIG. 27 is a rear elevational view of the protective pad apparatus of FIG. 26.

DETAILED DESCRIPTION OF THE INVENTION

[0048] A protective pad apparatus made according to the principles of the present invention comprises a shell assembly and an impact absorbing cushioning pad assembly lining the inner surfaces (the surfaces facing the athlete's body) of the shell assembly. The protective pad apparatus of the present invention is intended for use by athletes and other users who participate in contact sports, such as football players. It should be understood, however, that the protective pad apparatus of the present invention may also be used or adapted for use in other types of activities, which require impact protection, such as hockey, lacrosse, skateboarding, snowboarding, roller-skating, rodeo, stuntman, equestrian, motor sports, and all other activities where protective padding is necessary.

[0049] The protective pad apparatus is typically worn over the shoulders of the athlete's body to provide impact protection for the athlete's shoulders and upper torso, i.e., the chest, and back. As will become apparent further on, the protective pad apparatus 10 of the present invention features increased impact protection, allows the athlete's body to cool or thermo-regulate itself, provides the athlete with greater ease of movement and mobility, and restricts radiant heat transfer/absorption from the sun.

[0050] FIGS. 1-4 show an embodiment of a protective pad apparatus 10 of the present invention. The shell assembly of the pad apparatus 10 may comprise a plurality of discrete, substantially rigid protector panels which form a first shell halve H1 and a complementary second shell halve H2. The protector panels of each shell halve H1, H2 may include an arch-shape inner shoulder panel 12b, a chest panel 12a, a back panel 12e, an outer shoulder panel 12c, and a lower shoulder panel 12d. The outer shoulder panel 12c may be cup-shaped and somewhat elongated. The lower shoulder panel 12d may also be cup-shaped. The ends of the inner

shoulder panel 12b may overlap the upper ends of the chest and back panels 12a and 12e, as shown in FIG. 19. Fasteners 31 may be used to fasten the overlapping ends of the inner shoulder panel 12b and the chest and back panels 12a, 12e together. The outer shoulder panel 12c may be fastened to the inner shoulder panel 12b with a flexible strap 30a that may be constructed, without limitation, from a polyester webbing, which may be coated with polyurethane. A first end of the strap 30a may be fastened with one or more fasteners 31 to an inner surface (the surface facing the athlete) of the outer shoulder panel 12c and a second end of the strap 30a may be fastened with a rigid mounting plate 32 and one or more fasteners 31 to an exterior surface (the surface facing away from the athlete) of the inner shoulder panel 12b.

[0051] Still referring to FIGS. 1-4, the lower shoulder panel 12d may be fastened to the inner shoulder panel 12b with a flexible strap 30b that may also be constructed, without limitation, from a nylon web material and which may be coated with an elastomeric material. As shown in FIG. 15A, a first end of the strap 30b may be fastened with one or more fasteners 31 to an inner surface of the lower shoulder panel 12d and a second end of the strap 30b may be fastened with one or more fasteners 31 to an inner surface of the inner shoulder panel 12b. Alternatively, the lower shoulder panel 12d may be fastened to the inner shoulder panel 12b by a pair of flexible straps that may each be constructed, without limitation, from polyester webbing, which may be coated with polyurethane. As shown in the embodiment of FIG. 15B, the flexible strap, denoted by reference characters 130a and 130b, may cross one another and be connected together at the crossing point. The dual straps 130a and 130b allow the lower shoulder panel 12d to twist more freely, which in turn allows less restrictive movement of the shoulder.

[0052] A sternum protector plate 16 and a spine protector plate 18 may be used to connect the shell assembly halves H1 and H2 together. As shown in FIG. 16A, the sternum plate 16 may

include upper corner areas 16a and 16b, lower corner areas 16c and 16d, and fastener apertures 17a-d. As shown in FIG. 17A, the spine plate 18 may include upper corner areas 18a and 18b, intermediate areas 18c and 18d, lower corner areas 18e and 18f, and fastener apertures 19a-f. The upper and lower corner areas 16a-16d of the sternum plate 16 are fastened to the chest panels 12a with fasteners 31 as shown in FIG. 1. The upper and lower corner areas 18a-b and 18e-f, and the intermediate areas 18c-d of the spine plate 18 are fastened to the back panels 12b with fasteners 31, as shown in FIG. 2.

[0053] Referring again to FIG. 16A, the fastener apertures 17a-d of the sternum plate 16 may be horizontally elongated with the upper corner fastener apertures 17a-b slanted upwardly, and the lower corner area fastener apertures 17c-d slanted downwardly. Referring again to FIG. 17A, the fastener apertures 19a-f of the spine plate 18 may be horizontally elongated with the upper corner fastener apertures 19a-b slanted upwardly, and the lower corner area fastener apertures 19e-f slanted downwardly. The sternum and spine plates of FIGS. 16A and 17A, allow the tops or bottoms of the shells halves H1 and H2 to tilt inwardly toward one another as indicated by arrows 81 (FIGS. 1 and 2). The tilting feature allows the pad apparatus to move freely with the athlete's body so as not to hinder the athlete's flexibility or movement during play.

[0054] In an alternative embodiment of the sternum plate 16 shown in FIG. 16B, the upper corner area fastener apertures 17a-b may be horizontally elongated and slanted upwardly and the lower corner area fastener apertures 17c-d may be vertically elongated. Similarly in a corresponding alternative embodiment of the spine plate 18 shown in FIG. 17B, the upper corner area and intermediate area fastener apertures 19a-d are horizontally elongated and slanted upwardly (the intermediate area fastener apertures 19c-d may be slanted upwardly at a greater

angle than the upper corner area fastener aperture 19a-b), and the lower corner area fastener apertures 17c-d may be vertically elongated. The sternum and spine plates of FIGS. 16B and 17B, allow the tops of the shells halves H1' and H2' to tilt inwardly toward one another as indicated by arrows 81' (FIGS. 21 and 22). As in the previous embodiment, the tilting feature also allows the pad apparatus to move freely with the athlete's body so as not to hinder the athlete's flexibility or movement during play.

[0055] The spinal plate may also include preformed openings 34 (FIG. 2) for allowing accessories such as collars and neck rolls to be attached thereto without drilling holes which may weaken the shell assembly.

[0056] Referring again to FIGS. 1-3, one or more of the shell assembly panels 12a-e and the sternum and spine plates 16, 18 may be embossed in areas of the panels 12a-e and plates 16, 18 that are susceptible to stress fractures and cracks. The raised embossments 33 strengthen the panels 12a-e and plates 16, 18, thus, enhancing the overall structural integrity thereof and allowing the use of a thinner plastic, which in turn lowers the total weight of the pad apparatus 10. The raised embossments 33 may be configured in a variety shapes. For example, FIGS. 21-23 collectively show a pad apparatus 10' with differently shaped embossments 33' formed on the shell assembly panels 12a-e. The embossments may have one or more levels (the more levels, the stronger the panel area). For example, in the embodiment shown in the side elevational view of FIG. 18A, the raised embossment has a single level. In the embodiment shown in the side elevational view of FIG. 18B, the raised embodiment has two levels. Since the panels 12a-e and the protector plates 16, 18 of the shell assembly may be formed from plastic, they can be easily thermoformed with the embossments in conventional male/female molds.

[0057] The upper ends of the chest panels 12a, the inner shoulder panels 12b, and the upper ends of the back panels 12e may curve or bend away from one another to provide an opening O for the athlete's neck. The inner edges of the inner shoulder panels 12b may be covered with a biased binding 24, which may be made from nylon or any other material that prevents the inner edges from scraping or cutting of the neck.

[0058] The shell assembly panels 12a-e, the sternum and spine plates 16, 18, and the strap mounting plates 32 may be formed from a substantially rigid material or combination of materials, including without limitation plastic, aluminized plastic, and carbon fiber. In one embodiment, the shell assembly panels 12a-e, the sternum and spine plates 16, 18, and the strap mounting plates 32 are made from a plastic comprising a high density, high molecular weight polyethylene, and may be formed using conventional plastic forming techniques, such as thermoforming or injection molding. The thickness of the panels 12a-e and the plates 16, 18 may range, without limitation, between 0.110 inches and 0.140 inches.

[0059] The shell assembly panels 12a-e, the sternum and spine plates 16, 18, and the strap mounting plates 32 may be transparent, translucent, opaque or any combination thereof, and be any color or combination of colors. In one embodiment, the shell assembly panels 12a-e, the sternum and spine plates 16, 18, and the strap mounting plates 32 are opaque and a pearlized white metallic color. The white color reflects and retains less heat, and the metallic property acts to reduce the amount of heat absorbed by the shell assembly panels 12a-e, the sternum and spine plates 16, 18 and the strap mounting plates 32, by reflecting the light.

[0060] One or more venting apertures 26 may be formed in one or more of the shell assembly panels 12a-e and the sternum and spine plates 16, 18. The venting apertures 26 may circular and about 0.1875 inches in diameter. Such apertures may be placed between about 0.5 inches to

about 1.5 inches apart from one another. Venting apertures of other shapes, dimensions and spacings may also be used. The venting apertures 26 aid in transferring the heat generated by the athlete's body through the pad apparatus 10.

[0061] As shown collectively in FIGS. 4 and 5, an elongated spring element 20 may be provided that generally extends over the inner surface of each inner shoulder panel 12b. The front end 20a of each spring element 20 may be fastened to the inner surface of the shell assembly at the location where the inner shoulder panel 12b and chest panel 12a overlap one another, using fastener 31. Similarly, the rear end 20b of each spring element 20 may be fastened to the inner surface of the shell assembly at the location where the inner shoulder panel/back panel overlap one another, using fastener 31. The fasteners 31 may allow the spring elements to swing laterally a small amount as indicated by arrows 82. The spring element 20 functions to strengthen the inner shoulder panel 12b so that it resists "flattening" when impacted, and to absorb the energy and shock of the impact before it reaches the underlying cushioning pad assembly.

[0062] As shown in FIG. 20, each spring element 20 may comprise laminate including a somewhat rigid plastic substrate 20a, which may be, without limitation, about 0.60 inches in thickness. The outer surface of the substrate 20a (the surface facing the inner shoulder panel 12b) may be laminated with a impact absorbing material, such as a dense ethylene vinyl acetate (EVA) foam 20b, to pad the spring element 20. The inner surface (the surface facing the athlete) of the plastic substrate 20a may be laminated with a non-skid material 20c, such as rubber. The peripheral edge of the laminate may be covered with a fabric material 20d that is sewn to the edge of the laminate.

[0063] Referring again to FIGS. 1-4, the cushioning pad assembly lining the inner surfaces of the shell assembly, may comprise a plurality of discrete cushioning pads. The cushioning pads may comprise, for each shell assembly halve H1 and H2, a chest cushioning pad 14a (shown separately in FIGS. 6 and 7), which may be removably fastened with conventional snap-fasteners 22 to the inner surface of the chest protector panel 12a, a back cushioning pad 14e (shown separately in FIGS. 10 and 11), which may be removably fastened with conventional snap-fasteners 22 to the inner surface of back protector panel 12e, an inner shoulder cushioning pad 14b (shown separately in FIGS. 8 and 9), which may be removably fastened with conventional snap-fasteners 22 to the inner surface of the spring element 20, an outer shoulder cushioning pad 14c, which may be fastened with fasteners 31 to the inner surface of the outer shoulder panel 12c, a lower shoulder cushioning pad 14d, which may be fastened to the inner surface of the lower shoulder protector panel 12d, and a front deltoid cushioning pad 14f, which may extend between the outer shoulder pad 14c and chest pad 14a. The deltoid pad 14f does not line any of the shell assembly panels 12a-e but may have an unpadded or padded portion that allows it to fastened to the inner surface of the chest panel 12a and the inner surface of the inner shoulder panel 12b with fasteners 31.

[0064] As shown in FIG. 1, one or both of the chest pads 14a may be dimensioned to partially overlap the inner surface of the sternum protector plate 16 to provided cushioning under the sternum plate 16 to protect the athlete's sternum. Similarly, as shown in FIG. 2, one or both of the back pads 14e may be dimensioned to partially overlap the inner surface of the spine protector plate 18 to provide cushioning under the spine plate 18 to protect the athlete's spine. One or both of the chest pads 14a (shown in FIGS. 1, 6 and 7) may be configured to flare

outwardly at the bottom thereof (denoted by reference character F) to provide impact protection from belt buckle(s) 35b.

[0065] The fasteners 31 described herein may comprise conventional rivots or any other suitable fasteners. The snap-fasteners 22 described herein may comprise conventional circular snap-fasteners of the type having a male element 22a provided on the assembly panel or the pad and a female element 22b provided on the corresponding assembly panel or pad. The male and female snap fastener elements 22a and 22b may include alignment tabs (not shown), which provide a high degree of strength and allow separation thereof only when the tabs are properly aligned. The use of such snap-fasteners ensures that the pads will not come loose during impact and leave the athlete unprotected. The use of snap-fasteners 22 also aids in the efficient removal or addition of the cushioning pads. The cushioning pads utilizing the snap-fasteners can usually be replaced while the athlete or user is wearing the pad apparatus 10. Although less desirable, it should be understood, that hook and loop fasteners, zippers, and the like, or any combination of such fasteners may be used in place of the snap-fasteners 22.

[0066] Each shell assembly panel 12a-e and cushioning pad 14a-f of pad apparatus 10 can be individually replaced with a new or differently sized and/or shaped panel 12a-e or pad 14a-f using ordinary tools (to remove and reinstall fasteners 31). It is contemplated that each shell assembly panel 12a-e and cushioning pad 14a-f may be offered in a plurality of different lengths and/or widths and/or shapes to accommodate a wide variety of player body sizes, types and needs. Thus, if an athlete desires a differently sized and/or shaped assembly shell panel 12a-e and/or cushioning pad 14a-f because of injury, or just as a change of preference in style, the existing assembly shell panel 12a-e and/or cushioning pad 14a-f can be removed and replaced with the differently sized and/or shaped assembly shell panel 12a-e and/or cushioning pad 14a-f

as described above, to accommodate the athlete without the need to purchase a different pad apparatus. Still further, an athlete desiring more protection in the chest area and less protection in the back area, may remove the existing chest panel 12a and associated chest pad 14a and replace them with a longer and or wider chest panel 12a and chest pad 14a , and remove the back panel 12e and back pad 14e and add a shorter and slimmer back panel 12e and back pad 14e. If the athlete should then desire to change back to the original configuration, this can be accomplished at any time. All the shell assembly panels 12a-e and cushioning pads 14a-f may be made interchangeable to create a wide variety of models. Also, if one or more of the shell assembly panels 12a-e becomes damaged, the damaged panel or panels can be easily replaced.

[0067] The ability of the athlete's body to expel heat is of major importance in enabling the body to effectively cool itself. The cushioning pads 14a-14f are specifically constructed to allow the athlete's body to expel heat.

[0068] Referring to FIG. 12A, the inner shoulder pad 14b may comprise a laminate formed by an inner fabric layer 40 that faces the athlete's body, a first impact absorbing (IA) layer 41, a second IA layer 42, a third IA layer 43, and an outer fabric layer 44 that faces the shell assembly. The third IA layer 43 may be the firmest of the IA layers 41, 42, and 43 and the second IA layer 42 may be firmer than the first IA layer 41. The layers of the laminate may be held together using a very thin, web-like glue (not shown) disposed between adjacent layers, which allows air ventilation therethrough. One such glue is available from Bostick of Middleton, Massachusetts, under the trade name, Sharnet. The peripheral edge of the inner shoulder pad 12b may be covered or trimmed with a conventional fabric trimming 45 made, without limitation, from woven nylon, which may be sewn to the edge of the pad 14b.

[0069] The inner fabric layer 40 may comprise any well known brushed nylon material or other air-ventilating fabric, which is capable of functioning as the loop member of a hook and loop fastening system. The inner fabric layer 40 may be a dark color, such as black, for body heat absorption. The inner fabric layer 40 may alternatively comprise a fabric sold under the trade name, Dri-Lex, by Faytex Corporation of Weymouth, Massachusetts. The Dri-Lex fabric is available as a perforated fabric or as a doeskin-like fabric. Both types of Dri-Lex fabric are air-ventilating.

[0070] The first IA layer 41 may comprise one or more substrates of reticulated (open cell), polyurethane foam or other air-ventilating foam. In one embodiment, the first IA layer 41 may have a thickness of about 0.250 inches and a density of 1.30 pounds/cubic-foot. The first IA layer 41 may be a dark color, such as black, to absorb heat generated by the athlete's body. Reticulated polyurethane foam is available from a variety of vendors. For example, reticulated polyurethane foam may be obtained from Crest Foam Industries of Moonachie, New Jersey. The first IA layer 41 may alternatively comprise one or more substrates of a mesh-like, three-dimensional spacer material made from polyester. Such a mesh-like spacer material is sold by Muller Textiles, Inc. of Woonsocket, RI., under the trade name 3mesh. The mesh-like spacer material comprises two warp-knitted layers connected by pile monofilaments. When the mesh-like spacer material is used for the first IA layer 41, the inner fabric layer 40 may be omitted.

[0071] The second IA layer 42 may comprise one or more substrates of closed-cell foam beads made of cross-linked polyethylene, or polypropylene. The foam beads are fused together only at their contact points so that air can be ventilated through the substrate. Such a foam is sold under the trade name BROCK FOAM by Brock USA of Boulder, Colorado. In one embodiment, the second IA layer 42 may be about 0.250 inches in thickness and have a density of 4.0

pounds/cubic-foot (if more the one substrate, the substrates may have the same or different densities). It should be understood that any dense foam capable of ventilating air may be used as the second IA layer 42.

[0072] The third IA layer 43 may comprise one or more substrates of a visco-elastic dry polymer available from Magister Corporation of Chattanooga, Tennessee. In one embodiment, the IA layer 43 may be about 0.250 inches in thickness, and may be sized such that it covers only an intermediate area (the area disposed between stitching lines 46 as can be seen in FIGS. 12A-C, 8, and 9) of the second IA layer 42. It is contemplated that other very firm and/or dense materials capable of resiliently absorbing the impact forces that occur in contact sports and the like, may be utilized for the third IA layer 43.

[0073] The outer fabric layer 44 may comprise any well known air-ventilating fabric, such as a nylon mesh or perforated fabric. The outer fabric layer 44 may cover the portions of the second IA layer 42 not covered by the third IA layer 43. The outer fabric layer 44 may be light color, such as white, to reflect and not absorb heat generated from the sun's ultra-violet rays.

[0074] In other embodiments, the inner shoulder pad laminate may comprise the IA layers 41, 42, and 43 in a different order or position. For example, the position of the first and second IA layers 41 and 42 may be reversed such that the second IA layer 42 is laminated to the inner fabric layer 40 instead of the first IA layer 41.

[0075] In a further embodiment, as shown in FIG. 12B, the inner shoulder laminate may comprise a fourth IA layer 47 disposed between the outer fabric layer 44 and the portions of the second IA layer 42 not covered by the third IA layer 43. The fourth IA layer 47 may comprise one or more substrates of the closed-cell foam beads. The fourth IA layer 47 may be about 0.125 inches in thickness have density of about 5.5 pounds/cubic-foot.

[0076] In still another embodiment, as shown in FIG. 12C, the inner shoulder laminate may comprise a radiant heat barrier layer 48 disposed under the outer fabric layer 44. The radiant heat barrier layer 48 may comprise an aluminized polyester film. The aluminized polyester film may comprise an industrial grade aluminum film laminated to a polyester film or other type of fabric which provides the requisite tensile strength. Such an aluminized fabric may be obtained from Gentex Corporation (through Performance Textiles of Carbondale, Pennsylvania).

[0077] The inner shoulder pad 14b may include one or more channel pads 70 detachably fastened to the inner surface thereof as shown in FIG. 9. In the shown embodiment, the channel pads 70 may be fastened to ends of the inner shoulder pad 14b. Fastening may be accomplished using a conventional hook and loop fastening system. When the inner fabric layer 40 of the inner shoulder pad 14b comprises a material that is not hook and loop compatible, the earlier described snap fasteners (not shown) may be alternatively employed for detachably fastening the channel pads 70 to the inner surface of the inner shoulder pad 14b.

[0078] As shown in FIG. 12D, the channel pad 70 may comprise a laminate formed by an inner fabric layer 71 which faces the athlete's body, a IA layer 72, an outer fabric layer 73, and a hook layer 74. The outer fabric layer 73 and the hook layer 74 face the shell assembly. The layers of the laminate may be held together using the air-ventilating web-like glue (not shown) described above. The peripheral edge of the channel pad 70 may be covered or trimmed with a conventional fabric trimming 75 made, without limitation, from woven nylon, which may be sewn to the edge of the pad 70.

[0079] The inner fabric layer 71 may comprise a perforated fabric (e.g., perforated Dri-Lex), a brushed nylon fabric, or other air-ventilating fabric. The fabric may be a dark color, such as black, for body heat absorption.

[0080] The IA layer 72 may comprise one or more substrates of the earlier described closed-cell foam beads made of cross-linked polyethylene, or polypropylene, sold under the trade name BROCK FOAM by Brock USA of Boulder, Colorado. In one embodiment, the IA layer 72 may be about 0.250 inches in thickness and have a density of 4.0 pounds/cubic-foot (if more the one substrate, the substrates may have the same or different densities). In another embodiment, the IA layer 72 may comprise any dense foam capable of ventilating air.

[0081] The outer fabric layer 73 may comprise any well known air-ventilating fabric, such as nylon mesh fabric. The outer fabric layer 73 may be light color, such as white, to reflect and not absorb heat generated from the sun's ultra-violet rays.

[0082] The hook layer 74 may comprise a layer of hook material which is capable of detachably gripping to the inner fabric layer 70 of the inner shoulder pad 12b to detachably fasten the channel pad 70 thereto.

[0083] In another embodiment the channel pad laminate may comprise a radiant heat barrier layer disposed under the outer fabric layer. The radiant heat barrier layer may comprise the aluminized polyester fabric mentioned above. The channel pad laminate may also comprise additional IA layers of air-ventilating foams including, for example, one or more substrates of the earlier described reticulated foam and/or one or more substrates of the earlier-described mesh-like spacer material.

[0084] Referring to FIG. 13A, the chest, back, lower shoulder, and deltoid pads 14a, 14e, 14d, and 14f respectively, may each comprise a laminate formed by an inner fabric layer 50 which faces the athlete's body, a first IA layer 51, a second IA layer 52, and an outer fabric layer 53 which faces the shell assembly. The channel pad 70 described earlier may also comprise such a laminate. The second IA layer 52 may be firmer than the first IA layer 51. The layers of the

laminate may be held together using the air-ventilating web-like glue (not shown) described earlier. The peripheral edges of the pads 14a, 14e, 14d, and 14f may be covered or trimmed with a conventional fabric trimming 54 made, without limitation, from woven nylon, which may be sewn to the edges of the pads 14a, 14e, 14d, and 14f.

[0085] The inner fabric layer 50 may comprise a perforated fabric, such as the perforated or doeskin Dri-Lex fabric. The inner fabric layer 50 may also comprise other types of air-ventilating fabrics. The inner fabric layer 50 may be a dark color, such as black, for body heat absorption.

[0086] The first IA layer 51 may comprise one or more substrates of the earlier-described reticulated (open cell), polyurethane foam or other air-ventilating foam. The first IA layer 51 may have a total thickness of about 0.250 inches in thickness and a density of 1.30 pounds/cubic-foot. The first IA layer 51 may be a dark color, such as black, to absorb heat generated by the athlete's body. The first IA layer 51 may alternatively comprise one or more substrates of the mesh-like, three-dimensional spacer material sold by Muller Textiles, Inc. of Woonsocket, RI under the trade name 3mesh. When the mesh-like spacer material is used for the first IA layer 51, the inner fabric layer 50 may be omitted.

[0087] The second IA layer 52 may comprise one or more substrates of the earlier described closed-cell foam beads made of cross-linked polyethylene, or polypropylene, sold under the trade name BROCK FOAM by Brock USA of Boulder, Colorado. The IA layer 51 may be about 0.250 inches in thickness and have a density of 4.0 pounds/cubic-foot (if more the one substrate, the substrates may have the same or different densities). Alternatively, any dense foam capable of ventilating air may be used as the second IA layer 52.

[0088] The outer fabric layer 53 may comprise any well known air-ventilating fabric, such as a nylon mesh fabric. The outer fabric layer 53 may be light color, such as white, to reflect and not absorb heat generated from the sun's ultra-violet rays.

[0089] In an alternate embodiment as shown in FIG. 13B, one or more of the chest, back, lower shoulder, and deltoid pad laminates may comprise a radiant heat barrier layer 55 disposed under the outer fabric layer 53. The radiant heat barrier layer 55 may comprise the aluminized polyester fabric mentioned above.

[0090] Referring to FIG. 14, the outer shoulder pads 14c may comprise a laminate formed of an inner fabric layer 60, which faces the athlete's body, a IA layer 61, and an outer fabric layer 62, which faces the shell assembly. The layers of the laminate may be held together using the air-ventilating web-like glue (not shown) described earlier. The peripheral edge of the pad 14c may be covered or trimmed with a fabric trimming 63 made, without limitation, from woven nylon, which may be sewn to the edge of the pad 14c.

[0091] The inner fabric layer 60 may comprise any of the air-ventilating fabrics described herein. The inner fabric layer 60 may be a dark color, such as black, for body heat absorption.

[0092] The IA layer 61 may comprise one or more substrates of firm, dense EVA foam. The IA layer 61 may have a total thickness of about 0.250 inches in thickness, and may be a dark color, such as black, to absorb heat generated by the athlete's body. The IA layer 61 may alternatively comprise one or more substrates the earlier described closed-cell foam beads made of cross-linked polyethylene, or polypropylene, one or more substrates of the visco-elastic dry polymer, or any combination of EVA foam, foam bead foam, or visco-elastic dry polymer.

[0093] The outer fabric layer 62 may comprise the aluminized polyester fabric described earlier, which operates as a radiant hear barrier.

[0094] The reticulated polyurethane foam which may be used in the pads is environmentally friendly and very versatile. When compared to other foams, it offers substantial advantages in properties such as tensile strength, ease of fabrication, and depending on grade, its resistance to many chemicals, cleaning solutions, solvents, acids and alkalis. Reticulated polyurethane foams are also considered "non-nutrients" and are not ingested by microbial organisms and are often available with permanent fungicidal and bactericidal additives to enhance the antimicrobial activity. Accordingly, the pads stay a cleaner than the padding in conventional shoulder pad apparatus designs, which employ conventional foams encapsulated in a sealed nylon shell.

[0095] Another feature of the reticulated polyurethane foam is its ability to transport the perspiration from the wearers body into the foam itself and allow evaporation to occur more quickly and efficiently. When heat and pressure are used to manufacture reticulated foam, they create a flexible skeletal structure without cell membranes. The result is open-pore foam that can be produced in a wide range of precisely controlled pore sizes that may contain void volumes of up to 98%. This creates a large amount of "open space" to allow both airflow and absorption of liquids. Unlike the foams used in conventional pads, which smother the athlete's body and retain the liquid, the reticulated polyurethane foam pulls the heat and liquid into the foam while still allowing air circulation, ventilation, and evaporation to cool the shoulder pad apparatus more effectively and efficiently.

[0096] The closed-cell foam bead foam (BROCK FOAM) used in the pads functions to absorb impacts and more importantly, allow air, perspiration, and water to flow therethrough. Because the foam beads are fused together only at their contact points, heat generated by the athlete's body and outside air can flow freely through this foam thereby reducing the possibility of heat stroke and exhaustion.

[0097] The visco-elastic dry polymer is primarily provided in the pads for impact protection. The visco-elastic dry polymer is a soft synthetic rubber that is vulcanized by intensive cross-linking and cured into a stable solid. Compared to other foams or gels, visco-elastic dry polymer has superior load bearing capacity, elongation, elasticity, firmness, and tensile strength. The visco-elastic dry polymer resists full compression and evenly distributes the force of impact over its entire surface, thereby decreasing the chance that a high-risk area such as the Acromio Clavicular Joint will be negatively affected, resulting in injury. The visco-elastic dry polymer conforms comfortably to and moves easily with the athlete's body, and retains its original shape after deformation. The visco-elastic dry polymer is an excellent heat conductor, and therefore, functions as a heat sink to evenly absorb heat generated internally from the athlete's body. The heat absorbed by the visco-elastic dry polymer is transferred (conductive heat transfer), outwardly toward its edges, therefore, preventing "hot spots" in the pad as this entire layer is continually striving to become the same temperature. The conductive heat transfer properties of the visco-elastic dry polymer reduces tissue trauma because it prevents capillary closure (a breakdown of capillary blood vessels in skin tissue). In embodiments where the air-venting apertures are provided through the shell assembly panels, the corresponding substrate of visco-elastic dry polymer may be provided with a series of air venting apertures (not shown) which approximately align with the air venting apertures of the shell assembly panel, to provide additional heat dissipation.

[0098] The air-ventilating fabrics used in pads allow for free air and liquid flow, which enable the athlete's body to naturally cool itself. More specifically, the Dri-Lex fabrics may have a two-layer construction. The inner layer, (the layer against the athlete's body), is "hydrophobic" or water negative open cell foam. It absorbs moisture but does not evaporate it, which is what most

"moisture absorbent" linings do. They simply hold moisture, which means a damp, uncomfortable feeling against the body. To avoid this problem, the outer layer comprises a 100% Hydrofil nylon manufactured by Allied Signal Corporation, that draws the moisture from the inner hydrophobic layer, keeping that layer dry, cool, soft and comfortable against the body. This is a very important part of the athlete's comfort and safety. A drier cushioning pad is less likely to slip during a collision, keeping the pad in place and the athlete protected. The two-layer construction also has its own built-in ventilation system, which provides the shoulder cushioning pad with a high level of breath-ability. The high-quality fibers provide excellent wear resistance and retain shape longer. Because of Dri-lex's "thermostatic control" inside, the pads always feel dry, cool and comfortable to the athlete, as well as making the pads more hygienic.

[0099] The radiant heat barrier used in pads provide the athlete with an important level of thermal protection. Radiant heat barriers are typically made of materials that restrict the transfer of infrared radiation across an airspace. They do this by reflecting the radiation that strikes them, and at the same time, not radiating heat energy. A material that inhibits radiative transfer in this manner is said to have a very low emissivity (the relative power of a surface to emit heat by radiation). The lower the emissivity, the better the radiant barrier. This features enables the radiant heat barrier layer to be placed on either the inner (athlete body side) or outer (shell assembly side) of the pads, as one side reflects while the other side simply decreases the amount of emitted radiation. It is not necessary to form "airtight" seals with radiant barriers, as radiant energy travels in a straight line through the air, but is not transported by the air.

[00100] The thickness of the pads may be, without limitation, about 0.500 inches, although all of the pads of the cushioning pad assembly may be offered in different thicknesses. For example, if the athlete has an injury and needs more protective padding on the left side of his

body, the athlete can simply remove the existing pads, with pads of a desired increased thickness, for example, 0.625 inches. When the injury has healed (or at any time), the athlete may go back to the original pad thickness. Although not shown, the pads may also be formed as accessory "donuts" or "horseshoes" for specific orthopedic injuries in the shoulder area.

[00101] The pad apparatus may be secured to the athlete's upper torso with a belt strap system, as shown, for example, in FIGS. 1-4. The belt strap system may comprise a belt strap 35a and buckle 35b arrangement, provided on each halve H1, H2 of the pad apparatus 10. In other embodiments of the invention, the belt strap system may comprise a slide-ratchet belt strap arrangement (not shown), provided on each halve H1, H2 of the pad apparatus 10. The slide-ratchet belt strap is similar to the type of slide-ratchet belt strap system used on conventional ski boots or used to secure freight from shifting during transit. The slide-ratchet belt strap system allows for quick and easy placement and removable of the pad apparatus 10 of the invention. As shown in FIG. 24, each belt strap 35a may be provided with a cushioning pad 90 which may constructed similar to the chest or back pads or constructed from an elastomeric coated strap material. The protector pad 90 includes slots through which the strap 35a extends for cushioning the sides of an athlete's torso, adjacent the waistline. In another embodiment, as shown in FIG. 25, the chest and/or back pads can be laterally extended and provided with slots 92 through which the strap 35a extends for cushioning the sides of an athlete's torso, adjacent the waistline. As shown in FIG. 21, a buckle pad 93 similar in construction to the chest and back pads, can be attached to the inner surface of the buckle strap 35c to provide cushioning between the buckle 35b and the athlete's body.

[00102] Referring again to FIGS. 21-23, additional belts 36 may be provided on each halve H1, H2 of the pad apparatus for securing it to the athlete's upper torso. The additional belts 36 may

comprise an elastic strap fastened to each shell assembly back panel 12e (FIG. 22). The free end of each belt 36 may include a T-shape hook 36a (FIG. 23) which is inserted into an elongated slot 37 (FIG. 21) in the corresponding shell assembly chest panel 12a and rotated 90 degrees to retain the hook 36a in the slot 37. The tension of the belts 36 may be made adjustable using any conventional strap tightening system.

[00103] In another embodiment, as shown in FIGS. 26 and 27, the chest protector panel 12a'', the inner shoulder protector panel 12b'', and the back protector panel 12e'' of each shell assembly halve H1 and H2 may be formed as a single unitary member. The unitarily formed chest/inner shoulder/back panels may be embossed if desired.

[00104] While the foregoing invention has been described with reference to the above embodiments, various modifications and changes can be made without departing from the spirit of the invention. Accordingly, all such modifications and changes are considered to be within the scope of the appended claims.